Radon Presentation Notes

The U.S. EPA has declared home radon to be a silent killer. In this presentation students will learn what radon is and why it is not what the EPA wants you to believe.

Slide 3 – sources of background radiation graphic

- graphic from Lawrence Berkeley National Laboratory shows various sources of U.S. average annual dose from natural background radiation and relative contributions
- note that approximately 66% of natural background dose is from internal radiation sources, only 34% from external sources
- doses from cosmic and terrestrial contributors vary with location in U.S.
- average medical dose may vary in literature, depending on assumptions used to derive dose
- radon dose, largest single contributor to natural background radiation dose, may vary with location; however, average U.S. dose generally accepted as around 200 mrem per year

Slide 6 – radon decay chains graphic

- Ra-226 is daughter radioisotope in U-238 decay chain
- Ra-224 is daughter radioisotope in Th-232 decay chain

Slide 9 – EPA assault on home radon

- estimate of annual radon-related lung cancer deaths based on flawed LNT dose-response model
- no actual epidemiological data to support EPA estimates of radon-related lung cancer deaths

Slide 10 – EPA indoor radon remediation action level

- using quality factor of 20 for radon alpha radiation, high dose-rate threshold for potential biological harm is 0.4 mrem/hr; i.e. point at which dose-rate begins to overwhelm body's adaptive protection mechanisms
- inhaled radon dose of 800 mrem/yr is chronic average dose-rate of 0.091 mrem/hr, factor of 4.4 below high dose-rate threshold
- remedial action unwarranted for annual radon dose of 800 mrem

Slide 12 – both Rn-222 and Rn-220 doses evaluated in UNSCEAR Report

- dose to pulmonary region of lungs of much less significance than to basal cells of bronchial epithelium

Slide 13 – UNSCEAR 2000 Report radon dose calculations

- note that radon dose to lung tissue incorrectly identified in UNSCEAR 2000 Report as effective dose rather than equivalent dose
  — equivalent dose is organ- or tissue-specific dose

- — effective dose is whole body dose calculated as sum of equivalent doses for all exposed organs, accounting for individual organ sensitivity to radiation type

Slide 14 – UNSCEAR 2000 Report radon dose calculations (cont.)

- equilibrium factor defined as ratio of actual potential alpha particle energy concentration to concentration that would prevail if all radon decay products in equilibrium with parent radon (i.e., concurrent decay of all daughter radionuclides with parent decay)
- year-round indoor occupancy factor of 0.8 yields maximum indoor radon exposure

Slide 17 – UNSCEAR/EPA radon concentration/dose summary

- table shows average indoor and outdoor annual lung doses for UNSCEAR and EPA average indoor and outdoor Rn-222 concentrations
- calculated lung doses not very different

Slide 19 – Bernie Cohen indoor radon study

- slide illustrates fallacy of EPA home radon risk narrative
- study covered 1,601 U.S. counties comprising ≈90% of U.S. population
- graphic shows normalized lung cancer mortality rate of 1.0 corresponding to mean radon concentration of about 1 pCi/L
  - — radon concentrations less than 1 pCi/L show increase in lung cancer mortality
  - — radon concentrations between 1 pCi/L and 6 pCi/L show decrease in lung cancer mortality
- Cohen found average U.S. residential radon level to be 1.7 pCi/L
- 2021 Polish analysis of indoor radon data confirmed relative number of lung cancers decreases with increasing radon concentrations up to 5.4 pCi/L (200 Bq/m^3)
- graphic indicates no difference from normalized lung cancer mortality for UNSCEAR and LBNL average indoor radon concentrations (about 1 pCi/L), and decreased lung cancer mortality for EPA average indoor radon concentration of 1.3 pCi/L

Slide 22 – extrapolation of indoor radon study data

- extrapolation of Cohen data by J. Cuttler and C. Sanders (*Threshold for Radon-Induced Lung Cancer from Inhaled Plutonium Data*, 2015) predicts beneficial effect of home radon concentrations up to about 56 pCi/L (2100 Bq/m^3)

Slide 23 – indoor radon dose summary

- table shows calculated average annual indoor radon lung doses for UNSCEAR, U.S. EPA, Lawrence Berkeley National Laboratory, and Bernie Cohen indoor radon study average indoor radon concentrations

- doses were calculated using equivalent dose coefficient of 15 nSv(Bq hour m^{-3})$^{-1}$ from UNSCEAR 2000 Report

Slide 25 – radon concentration vs lung cancer mortality rate

- graphic compares predicted radon concentrations in areas of U.S. with observed lung cancer mortality rates
- after correction for smoking, significant negative correlation found between average residential radon levels and lung cancer mortality rates
- many areas of U.S. having higher indoor radon concentrations also exhibit lower lung cancer mortality rates
  - confirmation of how flawed LNT dose-response model is for low-dose ionizing radiation exposures
- if lower lung cancer mortality associated with higher indoor radon concentration, then radon cannot be dominant cause of lung cancer in areas of U.S. having highest lung cancer mortality rates
- graphic indicates that reducing indoor radon concentration below EPA home radon remediation action level of 4 pCi/L may be detrimental to human health

Slide 31 – radon spa controversy

- most famous Czech spa gained fame for treating musculoskeletal disorders and rheumatic diseases
- note that medicinal radon concentrations are 3 to 4 orders of magnitude higher than U.S. average residential radon concentration

Slide 32 – radon spa controversy (cont.)

- important point to note – no apparent regulation of very large acute radon doses for spa customers with strict regulation of chronic radon doses for spa workers
- European Union indoor remediation action level twice as high as EPA level, but neither based on epidemiological evidence of harm

Slide 35 – revisiting EPA radon assault (cont.)

- radon just another convenient boogeyman to frighten unknowing public by those with antinuclear agenda